DECLARATION

I, Tetsuaki Kamoda, a citizen of Japan, Kamoda International, P.A.O. of Rainbow Bldg. 8th Floor, 2-15-17 Nishi-shimbashi, Minato-ku, Tokyo 105-0003 Japan, do hereby sincerely declare:

(1) That I am well acquainted with the Japanese Language and English Language, and

(2) That the attached is a full, true and faithful translation into the English language made by me of the certification of the Paragraph 0015 to 0030 of JP TokuKai 2001-32911 publication on February 6, 2001.

This February 4, 2005 at Tokyo, Japan

Tetsuaki Kamoda

[0015]

[Mode for Carrying Out the Invention]

Figs. 1 to 2 show a first embodiment of the present invention. The one-way clutch built-in type pulley apparatus for alternator in accordance with the present example is formed to be cylindrical as a whole, and provided with a sleeve 8a which is fixedly fitted onto an end portion of a rotary shaft 3 (refer to Figs. 4 and 5) of the alternator and a non-driven pulley 7b which is located around this sleeve 8a and aligned concentrically with this sleeve 8a. Of these, the sleeve 8a is rotatable with this rotary shaft 3. Because of this, in the illustrated structure, a female screw portion 18 is formed on the inner peripheral surface of a middle part of the sleeve 8a, and this female screw portion 18 and a male screw portion (not shown in the figure) which is formed on the outer peripheral surface of an end portion of the rotary shaft 3 are arranged to be threaded with each other. Note that an arrangement for preventing a relative rotation between the rotary shaft 3 and the sleeve 8a may be attained by a spline, or by fitting between non-cylindrical surfaces, or by a key engagement, or by any other suitable means, instead of the screw. On the other hand, in order to make it easy to thread the male thread portion into the female screw portion 18, a hexagonal hole 19 is formed in the inner peripheral surface of the one end (the left end of Fig. 1) of the sleeve 8a such that the tip portion of a hexagonal wrench or the like tool can be engaged with the hexagonal hole 19.

[0016]

The non-driven pulley 7b around the peripheral surface of the sleeve 8a is provided with a pair of support bearings 20, 20 and a roller clutch 10a, which are located inside of the non-driven pulley 7b and will be described later. In addition, the outer peripheral surface of a half portion (the left half of Fig. 1) of the non-driven pulley 7b is formed to have a wave-formed cross section in the width direction so that a part of an endless belt called a poly-V belt is running therearound.

[0017]

Furthermore, in the case of this example, there

are provided the pair of the support bearings 20, 20 which are deep groove type ball bearings respectively and the single roller clutch 10a between the outer peripheral surface of the sleeve 8a and the inner peripheral surface of the non-driven pulley 7b. Of these, the support bearings 20, 20 are respectively constituted by inner races 22 having inner raceways 21 of deep groove type on the outer peripheral surfaces thereof, outer races 24 having outer raceways 23 of deep groove type on the inner peripheral surface thereof, and a plurality of rolling members (balls) 25 provided between each of the inner raceway 21 and each of the outer raceway 23 to be capable of rolling. Then, there are fixedly fitted, respectively by interference fit, the outer races 24 on the inner peripheral surface of the non-driven pulley 7b at locations near the opposite ends thereof and the inner races 22 on stepped portions 26 and 26 which are formed all the way around the outer peripheral surface of the opposite ends of the sleeve 8a. Also, in this condition, axial edges of the respective inner races 22 are abutted to the stepped surfaces 27, 27 between the stepped portions 26, 26 and the outer peripheral surface of the main portion of the sleeve 8a for the purpose of preventing the respective support bearings 20, 20 from being misaligned with the sleeve 8a in the axial direction.

[0018]

Furthermore, the respective rolling members 25 are rotatably held in a plurality of pockets 29 formed in a retainers 28 which is entirely ring shaped. Furthermore, seal rings 30, 30 are provided between the opposite ends of the inner peripheral surface of each of the respective inner races 22 and the opposite ends of the inner peripheral surface of each of the outer races 24. Then, the respective seal rings 30, 30 serve to prevent the entrance of foreign objects into the space in which the plurality of rolling members 25 are located and serve to prevent grease in the respective support bearings 20, 20 from leaking out.

[0019]

Also, for constituting such roller clutch 10a, a roller clutch inner race 31 for this roller clutch is

interference fitted on and fixed to the outer peripheral surface of the middle part of the sleeve 8a. This roller clutch inner race 31 is formed cylindrical as a whole of hard metal such as bearing steel or carburized steel such as SCM415, and is provided with a cam surface 32 formed on the outer peripheral surface thereof.

[0020]

On the other hand, an roller clutch outer race 33 is interference fitted on and fixed into the inner peripheral surface of the middle part of the non-driven pulley 7b. The roller clutch outer race 33 is formed cylindrical as a whole by press work of hard metal such as bearing steel or carburized steel such as SCM415 and provided with inwardly flanged brim portions 34a, 34b at the opposite ends in the axial direction. Incidentally, of these both brim portions 34a, 34b, the brim portion 34a (in the left side of Fig. 1) has the same thickness as the main portion of the roller clutch outer race 33 because it is formed in advance of assembling it with other constituent members. In contrast to this, the other brim portion 34b (in the right side of Fig. 1) is thinned because it is formed after assembling it with other constituent members. The outer brim portions of the respective brim portions 34a, 34b respectively come in contact with or very close to and facing, with a small gap, the inner end surfaces of the outer races 24, 24 of the respective support bearings 20, 20.

[0021]

Also, in a plurality of positions of the outer peripheral surface of the roller clutch inner race 31, recesses 35, 35 called ramp portions are formed at regular intervals in the circumferential direction of the roller clutch inner race 31, and the cam surface 32 is formed on the outer peripheral surface of this roller clutch inner race 31. While a cylindrical space 45 is formed between the outer peripheral surface of the roller clutch inner race 31 and the inner peripheral surface of the roller clutch outer race 33, the width dimension of the roller clutch outer race 33 in the radial direction as a dimension of this cylindrical space 45 is greater than the outer diameter of a plurality of rollers

36, located in this cylindrical space 45, at the position corresponding to each of the respective recesses 35 and smaller than the outer diameter of the respective rollers 36 at the positions displaced from the respective recesses 35.

[0022]

In addition, the roller clutch 10a is provided with a clutch retainer 37 in the form of a squirrel cage type cylinder which is made of synthetic resin, the plurality of the rollers 36 and a plurality of springs 38, 38 respectively between the inner peripheral surface of the roller clutch outer race 33 and the outer peripheral surface of the roller clutch inner race 31. Of these, the clutch retainer 37 comprises a pair of rim portions 39, 39, which are ring shaped respectively, and a plurality of column portions 40, 40 for joining these both rim portions 39, 39 together. Then, a plurality of pockets 41 and 41 are formed as a space surrounded on all four sides by the inner side surfaces of the respective rim portions 39, 39 and the side surfaces of the respective column portions 40, 40 such that the respective rollers 36 are supported rollingly and slightly displacable in the circumferential direction. Also, protruding portions 42, 42 are formed in a plurality of locations on the inner peripheral surface of the respective rim portions, and mounted on the roller clutch inner race 31 by engaging them with the recesses 35, 35 formed on the outer peripheral surface of the roller clutch inner race 31 so as to prevent the relative rotation to this roller clutch inner race 31. Incidentally, the axially opposite end faces of the clutch retainer 37 are respectively located very close to and facing the axially inner surfaces of these both brim portions 34a, 34b. In addition, the respective springs 38, 38 are provided between the column portions 40, 40 of the clutch retainer 37 and the respective rollers 36, which are elastically pressed in the same direction with respect to the circumferential direction (the left direction of Fig. 2).

[0023]

Particularly, in the case of the present invention, the diameter of the outer peripheral surfaces of axially outer portions of the pair of the rim portions 39, 39 provided at

the axially opposite ends of the clutch retainer 37 is smaller than the diameter of the outer peripheral surfaces of axially inner portions inwardly displaced from the axially outer portions. Accordingly, relatively large annular spaces 44, 44 are formed between the outer peripheral surface of the axially outer portion of the respective rim portions 39 and the inner peripheral surfaces of the opposite ends of the roller clutch outer race 33 of the roller clutch 10a.

[0024]

In accordance with the roller clutch built-in type pulley apparatus for alternator of the present example configured as described above, the roller clutch 10a serves to transmit rotating forces only in a predetermined direction between the non-driven pulley 7b into which the roller clutch outer race 33 is fixedly fitted, and the rotary shaft 3 onto which the sleeve 8a is fixedly fitted. For example, if it is assumed in Fig. 2 that the roller clutch inner race 31 is fixed and that only the roller clutch outer race 33 can rotate, when the roller clutch outer race 33 rotates in the clockwise direction in the same figure, the respective rollers 36 are inclined to move toward the deeper position of the recesses 35, 35, as illustrated in Fig. 2 with solid line, against the resilient force of the respective springs 38, 38 on the basis of the forces exerted on the respective rollers 36 by the inner peripheral surface of the roller clutch outer race 33. Then, the respective rollers 36 is enabled to rollingly move in cylindrical space 45 so that no rotating force is transmitted between the roller clutch outer race 33 and the roller clutch inner race 31, resulting in the so called overrun condition. the

Conversely, when the roller clutch outer race 33 rotates in the anti-clockwise direction in Fig. 2, the respective rollers 36 eat into the shallower position of the recesses 35, 35 like a wedge, as illustrated in Fig. 2 with chained line, against the resilient force of the respective springs 38, 38 on the basis of the forces exerted on the respective rollers 36 by the inner peripheral surface of the roller clutch outer race 33 and the resilient forces of the respective springs 38, 38, and therefore the roller clutch outer race 33 and the roller

clutch inner race 31 are integrally connected to freely transmit rotating forces between the roller clutch outer race 33 and the roller clutch inner race 31, resulting in the so called locking condition.

[0025]

It is possible by repeating the above action to fix the direction of the stress which acts upon a part at which this non-driven pulley 7b and the endless belt running around the non-driven pulley 7b rub against each other, and to prevent slippery between this endless belt and the non-driven pulley 7b and the shortening of the life of the endless belt. Also, when the rotating speed of the engine decreases so that the running speed of the endless belt tends to decrease, the sleeve 8a and the non-driven pulley 7b can freely rotate relative to each other (in the overrun condition) and therefore, the rotation can continue at a relatively high speed irrespective of the fluctuation of the rotating speed of the engine on the basis of the rotational inertial force of this rotary shaft 3, the rotor 5 fixed to this rotary shaft 3, the commutator 6 (Fig. 4) and the like, resulting in the improvement of the power generation efficiency of this alternator.

[0026]

Particularly, in the case of the roller clutch built-in type pulley apparatus for alternator of the present invention, it is possible to form the relatively large annular spaces 44, 44, which can be hold a sufficient amount of grease, between the outer peripheral surfaces of the opposite ends of the clutch retainer 37 in the axial direction and the non-driven pulley 7b or the inner peripheral surface of the roller clutch outer race 33 fixed to the inside of this non-driven pulley 7b. Thus, with the grease held in the respective annular spaces 44, 44, it is possible to maintain sufficient durability by decreasing heat generation due to the friction in the overrun condition in which the sleeve 8a and the non-driven pulley 7b rotate relative to each other, and preventing thermally degradation of the grease.

[0027]

Namely, in the case of the present invention,

since a sufficient amount of grease can be held in the annular spaces 44, 44 for lubrication of the roller clutch 10a, it is possible to decrease the above heat generation by sufficiently lubricating the abutment portion between the rolling contact surfaces of the respective rollers 36 and the members which come in sliding contact with the respective rollers 36. Particularly, in the case of the present invention, the grease contained in the respective annular spaces 44, 44 is scattered toward the inner peripheral surface of the roller clutch outer race 33 on the basis of the centrifugal force applied in practical use of the pulley apparatus, spread evenly over this inner peripheral surface, and applied to the portion serving as a raceway coming in contact with the respective rollers in order to sufficiently lubricate the portion where the heat generation due to friction is particularly problematic, i.e., the abutment portion between this inner peripheral surface and the rolling contact surfaces of the respective rollers 36.

[0028]

Furthermore, in the case of the present invention, the diameter of the outer peripheral surfaces of the axially inner portions of the pair of the rim portions 39, 39 of the clutch retainer 37 is larger than the diameter of the outer peripheral surfaces of the axially outer portions, and therefore it is possible to prevent the reduction of the strength of the joining portions between the respective rim portions 39, 39 and the respective column portions 40, 40 provided for joining the rim portions 39, 39 together, while the joining portions particularly need a sufficient strength as compared with other portions of the clutch retainer 37. Namely, since the respective rollers 36 move against the resilient force of the respective springs 38, 38 in the overrun condition, a load is applied to the respective column portions 40, 40 on the basis of the elasticity of the respective springs 38, 38. Accordingly, it is required to maintain the sufficient strength of the joining portions between the respective column portions 40, 40 and the respective rim portions 39, 39. In contrast to this, since the diameter of the outer peripheral surfaces of the axially inner portions of the respective rim portions 39, 39 is increased in

the case of the present invention, the strength of the joining portions is not decreased. As a result, in accordance with the present invention, it is possible to maintain sufficient durability of the pulley apparatus without compromising durability of the clutch retainer 37.

[0029]

Incidentally, in the case of this example, there is a large diameter portion 46 formed in the inner peripheral surface of the one end (the left end of Fig. 1) of the non-driven pulley 7b and having a diameter larger than the outer diameter of the outer races 24, 24 of the support bearing 20, 20. Then, of the pair of the support bearings 20 and 20, one support bearing 20 (in the left side of Fig. 1) is provided with the outer race 24 which is fixedly fitted into the inner peripheral surface of the non-driven pulley 7b at the location inwardly displaced in the axial direction from the large diameter portion 46. While there are fixedly fitted, respectively by interference fit with an interference, the outer races 24 of said one support bearing 20 on the inner peripheral surface of the non-driven pulley 7b and the inner races 22 on the outer peripheral surface of the sleeve 8a, in the case of this example in which the large diameter portion 46 is formed in the inner peripheral surface of the non-driven pulley 7b as described above, it is possible to reduce the length for which this outer race 24 is moved with an interference into the non-driven pulley 7b for interference fitting the outer race 24. Accordingly, it is possible to prevent excessive pressure increase in the space in which the roller clutch 10a is located between the pair of the support bearings 20, 20 and which is tightly closed at its opposite ends by the seal rings 30, 30 attached to the support bearings 20, 20. Because of this, it is possible to prevent the respective seal rings 30, 30 attached to the support bearings 20, 20 from curling.

[0030]

Next, Fig. 3 shows a second embodiment in accordance with the present invention. In the case of this example, an engagement protrusion 47 inwardly protruding in the radial direction is formed all the way around the inner

peripheral surface of one end in the axial direction (the left end in Fig. 3) of the clutch retainer 37a of the roller clutch 10a. On the other hand, a plurality of engagement parts 48 which are respectively hook-like shaped and inwardly protruding in the radial direction are formed fragmentarily around the inner peripheral surface of the other end in the axial direction (the right end in Fig. 3) of the clutch retainer 37a.